

## **Broadening the Base of Hypermedia Specifications**

### **Final Report**

**A Short Term Research and Development Task  
Proposed Under DLA900-87-D-0017  
Delivery Order #0027**

**26 May 1992 – 30 September 1994**

**19960726 119**

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**DLA900-87-D-0017-0027**

# REPORT DOCUMENTATION PAGE

Form Approved  
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)			2. REPORT DATE Jan 1995	3. REPORT TYPE AND DATES COVERED Final 05/26/92 - 09/30/94
4. TITLE AND SUBTITLE  Broadening the Base of Hypermedia Specifications			5. FUNDING NUMBERS DLA900-87-0017 Del. Ord. # 0027	
6. AUTHOR(S)  Dr. Gene A. Tagliarini Dept. of Computer Science				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)  Clemson Apparel Research Clemson University 500 Lebanon Road Pendleton, SC 29670			8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)  Defense Logistics Agency Room 4B195 Cameron Station Alexandria, VA 22304-6100			10. SPONSORING/MONITORING AGENCY REPORT NUMBER Defense Personnel Supply Ctr. 2800 South 20th St. Philadelphia, PA 19101-8419	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION / AVAILABILITY STATEMENT			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words)  This report describes the development of a hypermedia presentation of the specifications for the production and evaluation of the Army men's shirt sleeve dress shirt and protective suit. Specifically, the data base incorporates the content of the specification for the manufacture of the Army men's short sleeve dress shirt [6], the quality assurance provisions for Army shirts [7], and the production of the chemical protective suit [8]. In addition, a presentation pattern for developing an entire library of specifications was established.				
14. SUBJECT TERMS			15. NUMBER OF PAGES 15	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT  unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE  unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT  unclassified	20. LIMITATION OF ABSTRACT  unclassified	

NSN 7540-01-280-5500

## **1.0 Introduction, Background and Research Objectives**

### **1.1 Introduction**

Presenting military apparel specifications in a manner that effectively communicates the requirements that they embody has become an intensely complex task. Information specifying both manufacture and evaluation requirements has produced documents that are multifaceted and intertwined. As a result, ascertaining that a garment, or the process by which it is produced, complies with all requirements is both tedious and error prone. In contrast, recent advances in computer hardware and software have made it possible to develop specification databases that are easily accessible even if massive and highly interconnected. Furthermore, these databases may contain any computer manageable form of information. The resulting hypermedia databases bridge the communication gap by conveying related requirements through electronically linked documents that can be reviewed according to the focus of the reader. This research report describes the development of a hypermedia presentation of the specifications for the production and evaluation of the Army men's short sleeve dress shirt and the chemical protective suit.

This project extended previous work which had resulted in a hypermedia presentation of the specification for the dress shirt; however, the presentation was capable of running only on a Macintosh computer. Since numerous potential users of the system were committed to IBM-PC compatible platforms, this project was conceived to enable them to derive the benefits of a database of hypermedia versions of specifications. Specifically, the database incorporates the content of the specification for the manufacture of Army men's short sleeve dress shirt [6], the quality assurance provisions for Army shirts [7], and the production of the chemical protective suit [8]. In addition, a presentation pattern for developing an entire library of specifications was established.

### **1.2 Background**

Frequently, the details conveyed in one section of a document may affect the way requirements that appear elsewhere are interpreted. A web of related requirements may be

found that stretches through several parts of multiple documents. This complicated situation arises when requirements are assembled into a written document. When one organizes an information hierarchically, as illustrated in Fig. 1, an attempt is made to collect correlated specifications in the various sections. Unfortunately, the tree-like organizational structure associated with a hierarchy does not always permit related requirements to be located near each other in the text (and possibly not even in the same document). When the document must be interpreted, in order to assure that all of the requirements are met, one must pursue the references that the text makes to itself and to other specifications.

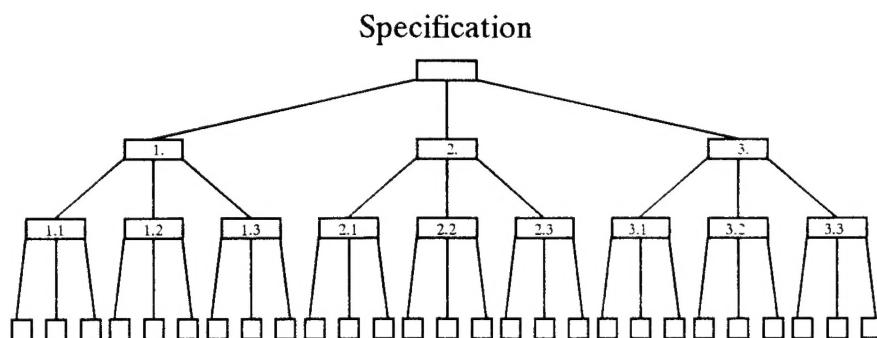


Fig. 1. Hierarchical Organization

Consequently, one needs the ability to review specifications nonsequentially. Clearly, if the ability to review a specification in arbitrary order is provided, the person using the system will also have the capacity for hierarchical and sequential access. All three types of access order, sequential, hierarchical and nonsequential, are illustrated in Fig. 2.

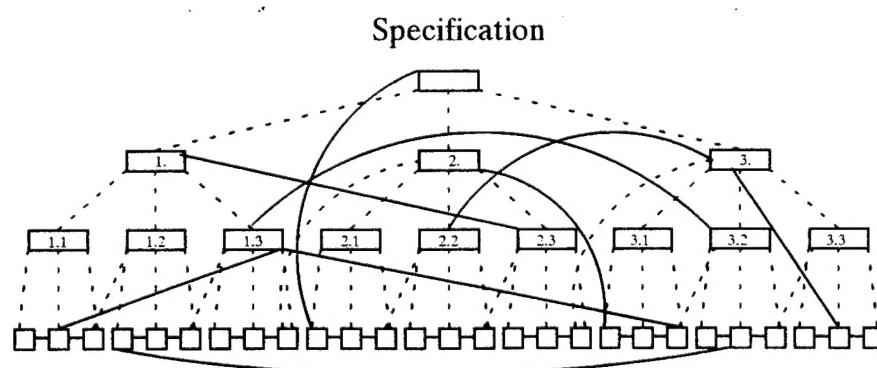


Fig. 2. Hypermedia Organization

Consider, for example, the Army uniform specification MIL-S-44041B(GL) [6] for a short sleeve man's shirt. This document details the requirements for materials, construction, packaging and *some* quality evaluation of the shirt. Nevertheless, it does not include certain important quality evaluation criteria such as the proper alignment of pocket flap buttonholes with the corresponding front buttonhole. This requirement is part of MIL-STD-1492C [7] that describes provisions for evaluating the quality of the garment. Consequently, to be aware of the requirement, one must be cognizant a separate document.

In addition to the organizational complexities of written specifications are the difficulties that may be associated with interpreting those specifications. Frequently, specifications contain few, if any, figures to illustrate the requirements. In particular, the shirt specification MIL-S-44041B(GL) contains only one figure. The related quality evaluation specification MIL-STD-1492C, with more than 20 pages of visual defect grading criteria, contains only 3 illustrations. Nevertheless, both documents contain numerous requirements that could be clarified by illustration.

A third problem associated with the way that specifications are commonly presented is that they are typically in printed form. Since specifications periodically require updating and printed forms do not lend themselves to revision, it is difficult to maintain a current version of the requirements. Indeed, one may find versions of specifications in use that are literally pasted pieces of revisions to the requirements. Failure to acquire useable revisions in a timely fashion can severely interfere with the competitiveness of a contractor.

### **1.3 Research Objectives**

The primary goals of this project were to broaden the base of potential users of hypermedia presentations of specifications by developing an IBM-PC compatible presentation and to include an additional specification in the library. Both of these objectives were addressed by using existing IBM-PC compatible hardware and data management programs. A hypermedia presentation of the specifications MIL-S-44041B(GL) [6], MIL-STD-1492C [7] and MIL-S-43926H [8] was produced.

## **2.0 Authoring Tools and the Development Environment**

The first activity on the project sought to determine if there were an automatic means by which to convert the hypermedia database developed in earlier research from the Macintosh computer form to one capable of executing on an IBM-PC compatible computer. There was no program with the ability to perform the necessary conversion.

Subsequent efforts sought to determine the most effective means to enter the text of the specifications into an electronically manageable form. While there were scanners with the capability of reading certain type fonts, our investigations revealed that the resulting text files were likely to contain translation errors that would, in turn, require the text of the specification to be proofread. Consequently, we explored the alternative environments for developing and executing hypermedia presentations. In particular, two windowing systems were evaluated: X-Windows and Microsoft Windows<sup>®</sup>. While numerous applications were being developed for the X-Windows environment, it was clear that the potential users of the hypermedia presentations of specifications were more likely to be familiar with Microsoft Windows<sup>®</sup>. As a result, we focused our evaluation of authoring software on programs capable of generating presentations that could run in the context of Microsoft Windows<sup>®</sup>.

In order to perform a side-by-side comparison of hypermedia authoring and development alternatives, evaluation kits were ordered from Asymetrix Corp. (whose hypermedia product is called Toolbook<sup>®</sup>), Innovative Communication Systems Inc. (Ask•Me 2000<sup>®</sup>), Interactive Image Technologies Ltd. (HyperCASE<sup>®</sup>), OWL International Inc. (Guide<sup>®</sup>) and Spinnaker Software (Plus<sup>®</sup>). These packages were assessed on the basis of factors that included computer hardware requirements, the ability to incorporate, produce and present images, the capabilities of the scripting language and its potential for extension through external functions, support for multimedia devices, the ability to search for key words or phrases, and licensing requirements that could affect the distribution of the hypermedia version of the garment specifications. Toolbook<sup>®</sup> (Asymetrix Corp.) was found to provide the capabilities that were needed without license constraints that were found in other products. The next sec-

tion describes hypermedia in general and illustrates both the tools and the techniques that were employed in developing the hypermedia presentations for this project.

### **3.0 Hypermedia**

#### **3.1 Definitions**

The word “hypermedia” was derived from the term “hypertext” which was coined by Nelson[4] to refer to textual information that was organized so that related content could be readily reviewed. The use of hypermedia has been described as a significant paradigm shift in information management systems [1]. It has been applied to organize and to present EPA regulations for underground storage tanks [2]. In addition, Schneiderman and Kearsley [5] cite applications of hypermedia to such diverse areas as dictionaries, encyclopedias, medical texts, catalogs, interactive fiction, religious documents and museum exhibits. As computer technology has advanced, it has become possible to use electronic documents to convey various media forms including audio, graphics, animations and video in addition to simple text. Hypermedia has come to refer to any information base that employs various media and is organized so that related segments of information can be rapidly accessed. Thus, there are two key elements of hypermedia: media and access.

#### **3.2 Media**

Any computer manipulable form of information can be embedded in hypermedia. The text and drawings that are parts of a specification can be incorporated as they would be in a paper version. In addition, digitized audio can be used to supply verbal explanations or amplifications of requirements. Digital video can be used to capture images or even brief moving sequences to illustrate and clarify the textual content. Nevertheless, media by themselves provide only limited improvements over printed documents. It is critical to be able rapidly to access the segments of a specification that bear upon a requirement that is currently of interest.

#### **3.3 Access**

Access to related information is provided through a collection of hypermedia navigation tools including buttons, drop-down menus and “hotwords.” A button is a region on a comput-

er's display that is typically identified using an icon and has special properties. In particular, if a mouse pointer is used to place the cursor over a button icon and a mouse button is "clicked," then the information represented by the icon will be presented.

Drop-down menus are lists, normally hidden from view, of alternative actions. The lists are summarized by a key word or phrase which appears on a menu bar of the display window. When the mouse cursor is placed on the key word or phrase and a mouse button is depressed, the menu appears. An action can be selected from the menu by sliding the cursor down the menu to the desired item and then releasing the mouse button.

The suite of hypermedia navigation tools is completed with "hotwords," which are segments of the text itself that can function like buttons. A hotword is typically highlighted with italics, a text framing box or a change in the font color. One selects the action associated with the hotword by pointing and clicking with the mouse analogously to the way in which buttons are used. Thus, any piece of the text of a specification can be linked to any other data stored in a hypermedia information base. With the navigation capabilities provided by buttons, drop-down menus and hotwords, hypermedia presentations can be developed. Figure 3 illustrates the use of buttons to select a sequence of displays from a specification's Table of Contents, to the section on packaging, and then to the subsections on palletization and marking, eventually returning to the Table of Contents. Notice that the steps do not correspond to a sequential review of the specification's contents. Specific examples illustrating the various navigation tools as they have been used in the hypermedia library which was developed will be given in the following section.

### **3.4 Organization and user interfaces for hypermedia**

An essential element of any presentation is organization and hypermedia is no exception. Our research involved establishing the framework for a library of specifications that detail requirements of various elements of military apparel. Figure 4 shows a window from the hypermedia presentation of the specifications and reflects the relationships between the specifications that are in the library. For information bearing on the chemical protective suit or the

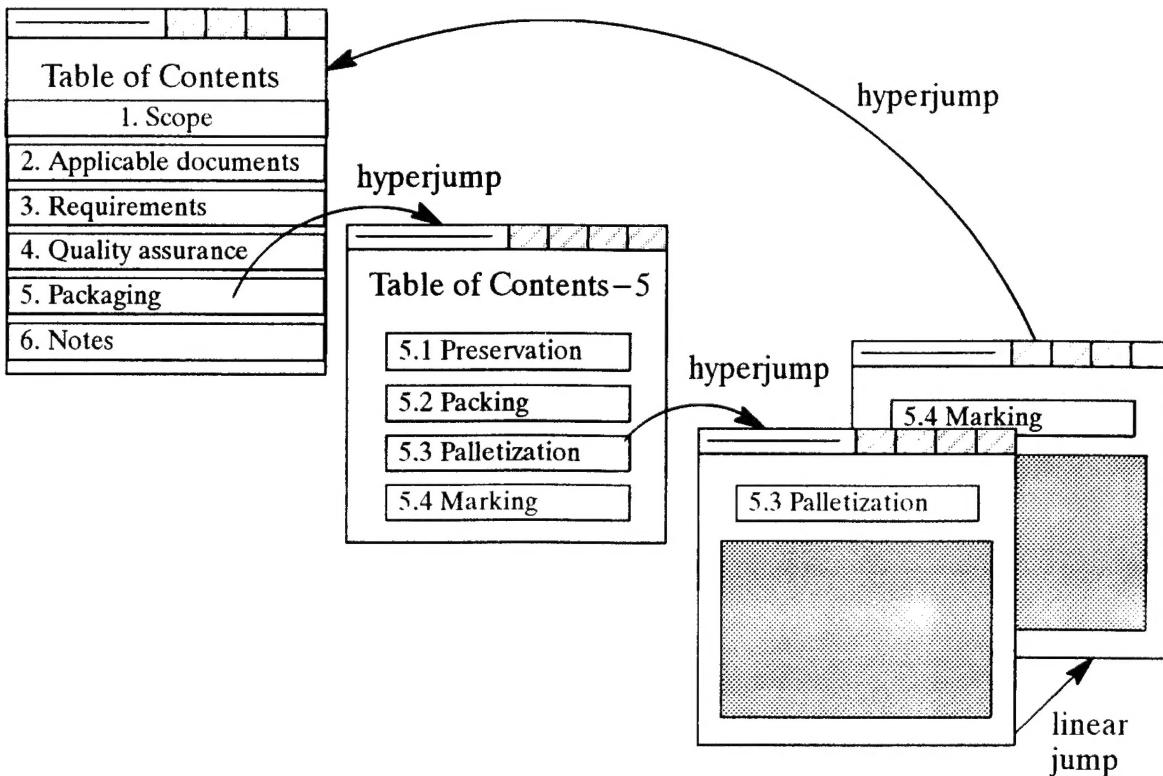


Fig. 3. Hyperdocument navigation

Army men's short sleeve dress shirt one merely clicks a mouse button while the cursor is over the corresponding region of the display window.

One aspect of the organization of written documents is reflected in their tables of contents. Through the use of hypermedia, one may provide all the hierarchical structure reflected by a textual table of contents through a graphical presentation such as the one illustrated in Fig. 5 or through a set of drop-down menus as illustrated in Fig. 6. These menus, such as the one whose caption is "Topics," progressively refine the level of access to the information in a specification. Of course, the hierarchical structure embedded in the menus can be supplied in addition to any other linking or indexing that one chooses to incorporate into a hypermedia presentation of a specification.

Notice that Fig. 6 actually illustrates several hypermedia, navigational tools. In addition to the "Topics" menu shown in full, there are two other menus: "Detailed Requirements" and "Switching Procedures," each providing access to more detailed information. There are also certain standard buttons such as "Home" that enables one to return to the top level of the spec-

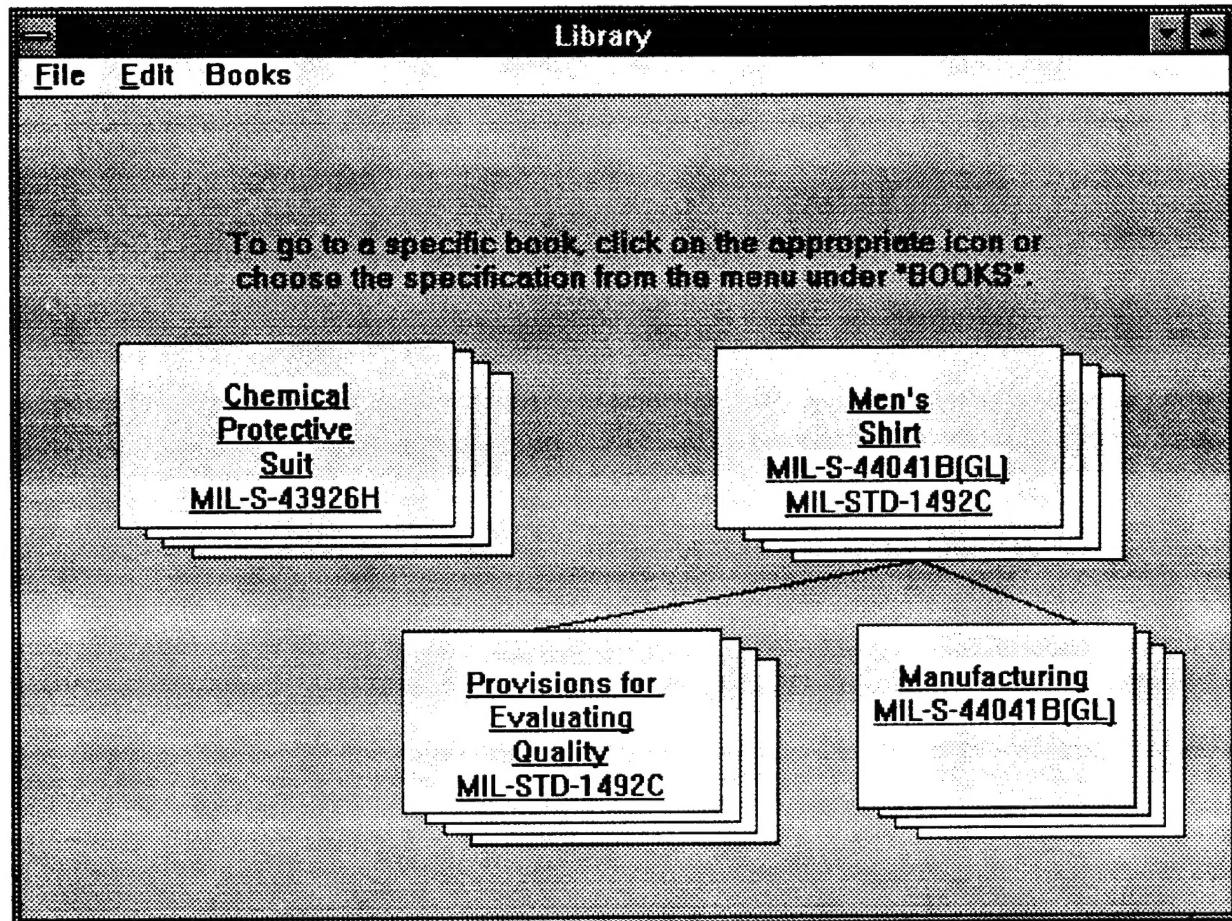


Fig. 4. Current library of specifications

ification index and "Library" that would take one to the display in Fig. 4. Finally, observe (in Fig. 6) the hotwords "applicable first value" which link the hypermedia user to additional lot-acceptance information.

The organization of a hypermedia document also presents several novel opportunities. For example, using hypermedia, one has the capability of augmenting the textual table of contents with a visual table of contents. For the presentations described here, we developed a collection of drawings of the Army men's short sleeve dress shirt and the chemical protective suit that were used to allow one to select the garment and details of interest by simply pointing and clicking at garment images. These images portray increasing levels of the details for each garment. The top levels of the visual tables of contents, taken directly from the hypermedia

presentation for the men's shirt and the chemical protective suit, are shown in Figs. 7 and 8, respectively.

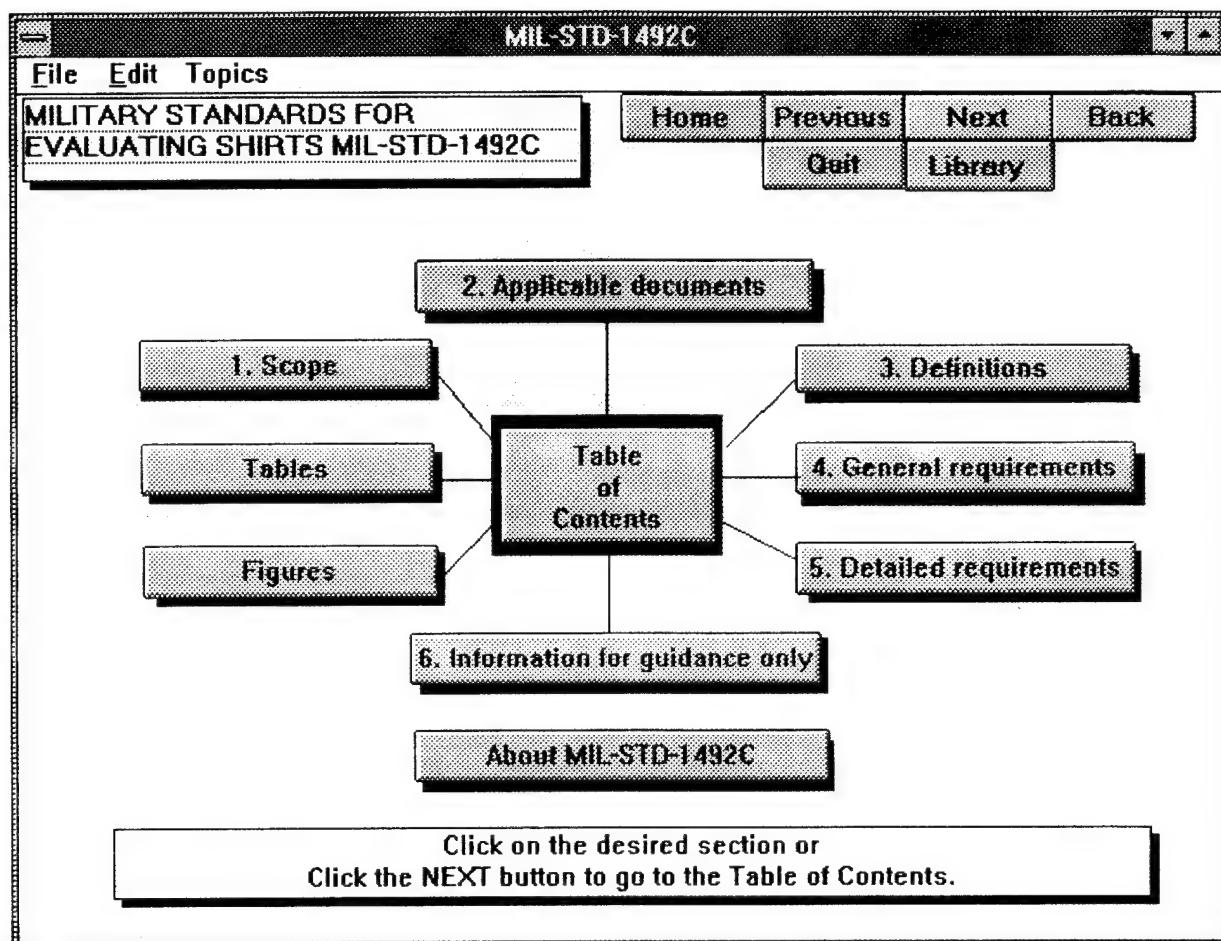


Fig. 5. Specification table of contents

A third element of hypermedia organization is the user interface. A balance must be struck between visual activity and presentation consistency. While users of hypermedia presentations are becoming increasingly comfortable with computers, the navigational flexibility afforded by hypermedia links can be disorienting. Consequently, hypermedia presentations employ certain techniques to ease the burden of maintaining orientation. Among these are: the consistent use of background colors so that each specification has a unique background hue; standard page layouts that implement the general structure of the specification; and provision of a home page and buttons linking each display to the home page. With these features, a

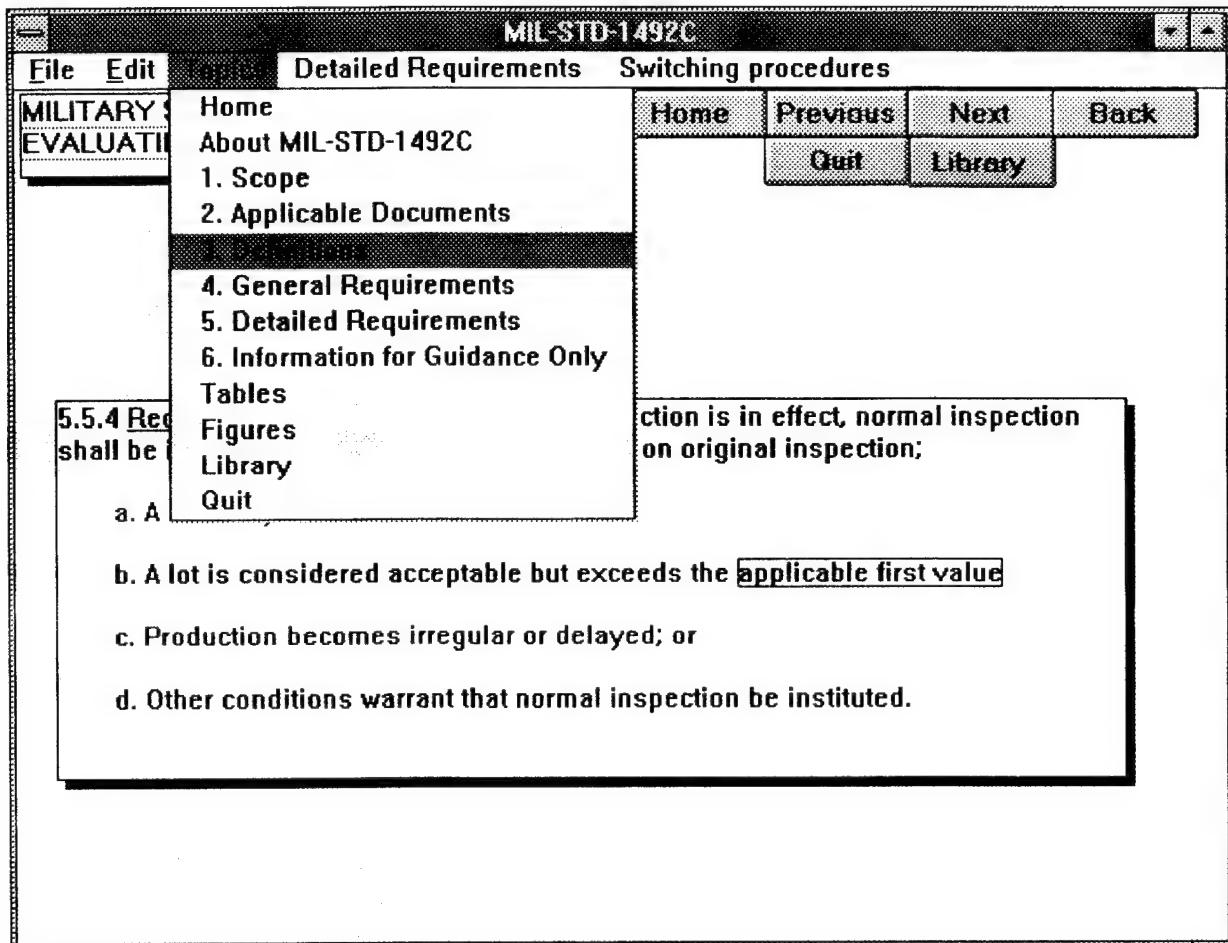


Fig. 6. Buttons, drop-down menus, and hotwords

hypermedia presentation can be perused along any intricate thread of interest and the reviewer will maintain his control over the presentation mechanisms.

#### 4.0 Other Features and Details

##### 4.1 Keyword Searching

While the hypermedia navigation tools afford rapid access to any segment of a specification that is of interest, there are some potential users who may not be aware of the sections of a specification that bear upon their interests. For example, a button vendor may have very focused interests in only those requirements that deal with his particular products. However, the references that are made to buttons may conceivably occur almost anywhere within a specification. In order to enable one to locate all the references to a particular word or phrase within a

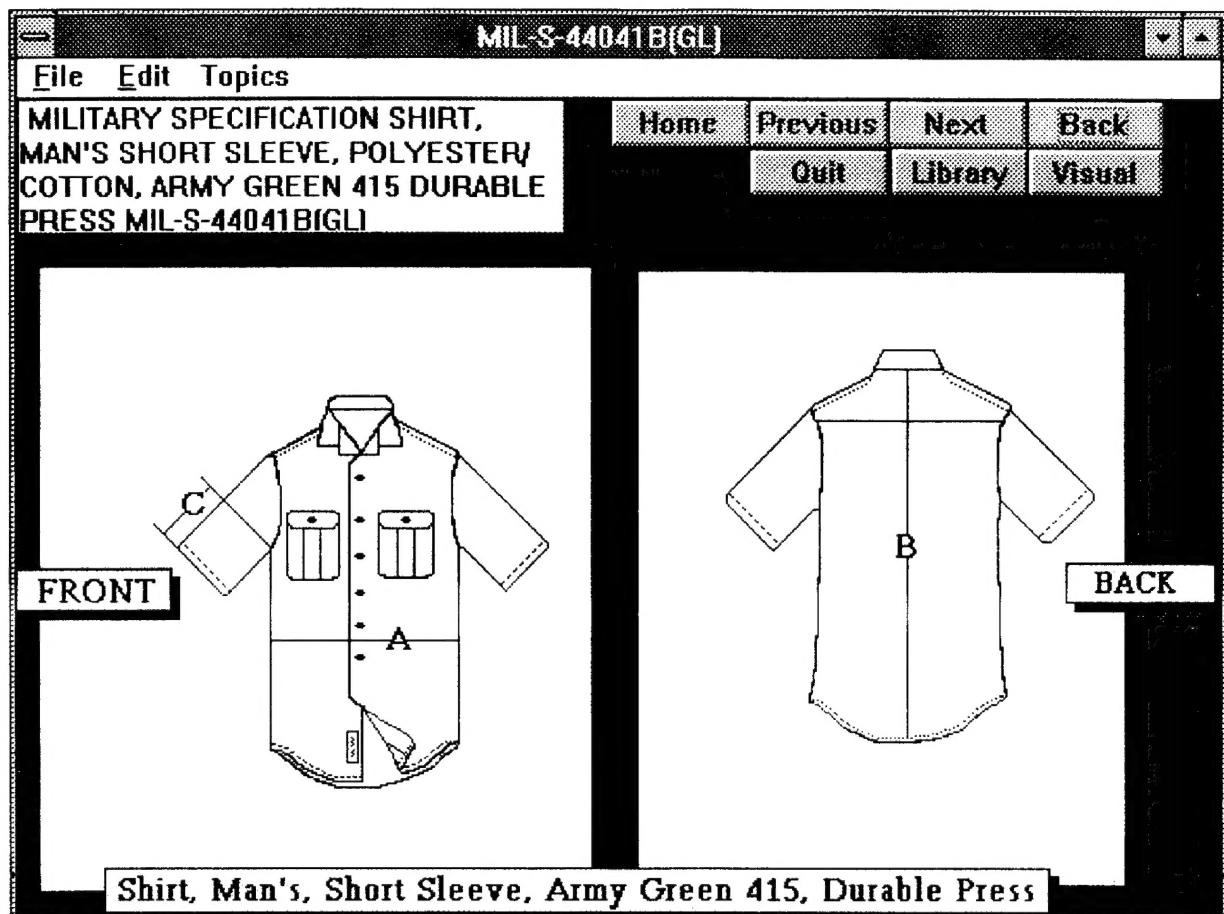


Fig. 7. Visual "Table of Contents"

specification, a keyword search engine was included in the specification library developed during this project.

#### 4.2 Results

The presentation developed during this investigation includes approximately 200 hypermedia pages employing a variety of formats and graphics. The hypermedia version of the specifications, MIL-STD-1492C, MIL-S-44041B(GL), and MIL-S-43926H has been stored and related segments within the appropriate specifications are linked. The resulting hypermedia presentation is capable of executing on an IBM-PC compatible computer but because it incorporates the programs that are necessary to present the hypermedia project, the storage requirements for the stand-alone version of the project are large. However, it can be reviewed without acquiring hypermedia authoring or development programs.

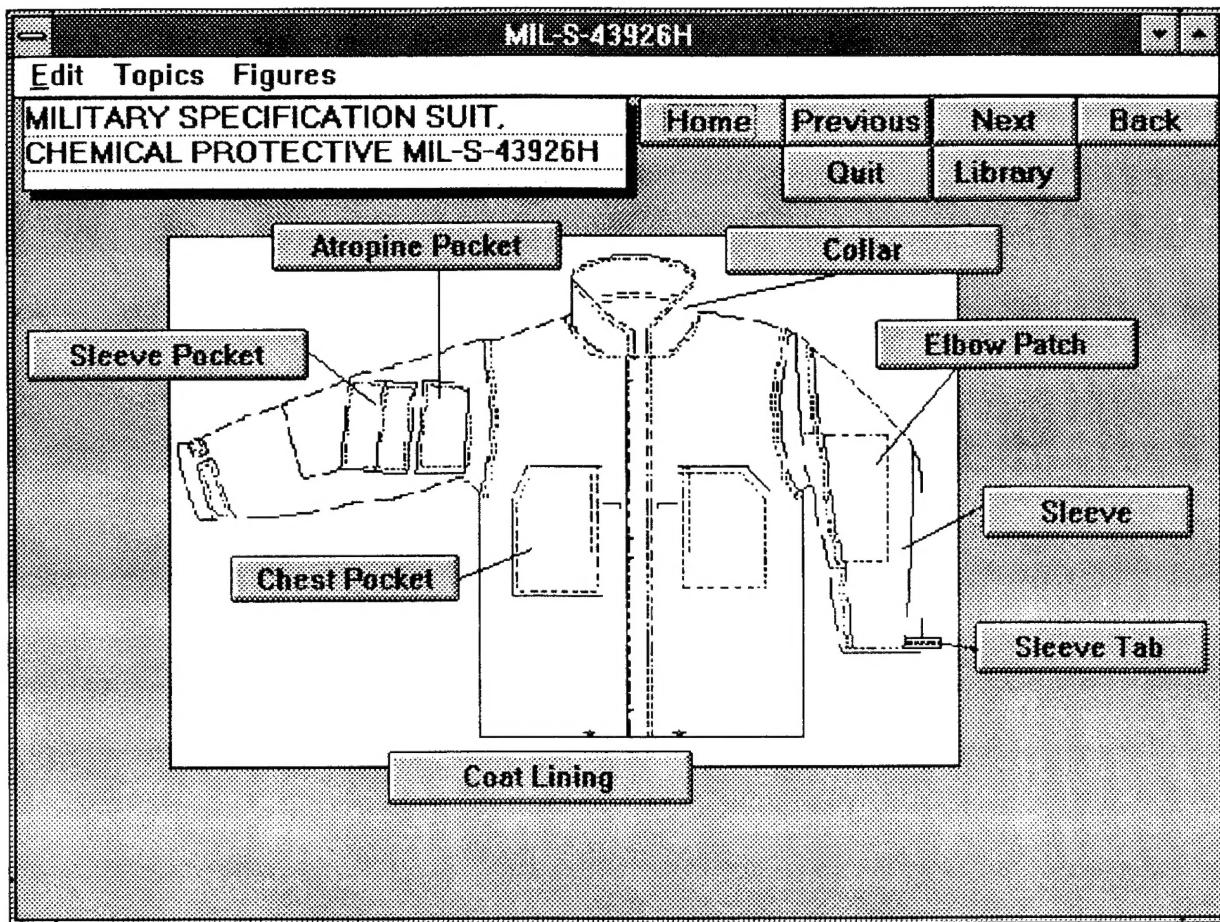


Fig. 8. Visual "Table of Contents" for the chemical protective suit

Since the stand-alone version of the presentation is large, distribution of the presentation posed a potential problem. However, a correlated research project (Delivery Order #0028) was in progress and its findings bore on the need for an appropriate medium for distribution. The related project was investigating the possibility of using the mass storage capabilities of compact disk read-only memory (CD-ROM) technology to enable an immense amount of supplemental information to be distributed with a specification. Since CD-ROM's offer the capacity to store over 500 MBytes of information in a nonvolatile medium, it was apparent that the specification library could be readily incorporated onto a CD-ROM together with the hypermedia presentation results of that project.

## **5.0 Conclusions**

A wide variety of potential users, including apparel manufacturers, material vendors, specification writers and quality assurance inspectors, should benefit from the use of hypermedia apparel specifications. Manufacturers will benefit from having accessible, linked, up-to-date versions of the specifications available while bids are being formulated and during production. Material vendors will be able to access the requirements that are pertinent to their individual products without plowing through extraneous requirements. Specification authors will possess powerful tools that permit requirements to be linked and audio-visual supplements to be integrated so that the goals of the specifications can be more effectively communicated. In addition, inspectors, who must be knowledgeable of the requirements for a wide variety of defense acquisitions, will be able quickly to review the exact specifications each item must meet; hence, the inspector's role in quality assurance will be supported.

## **6.0 Future Extensions**

There are a number of very natural ways to extend the utility of this research project. First, one could explore the use of voice controlled hypermedia navigation to provide "hands-free" operation in support DLA inspection activities. Second, one could enlarge the database to incorporate the full complement of uniform specifications. Perhaps even more useful to DLA would be to develop a training program by which specification writers, who are the people with the most intimate knowledge of the requirements, could conduct their authoring activities in a hypermedia development environment. A program that leads to the creation of specifications in a hypermedia format could be extremely powerful.

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